Space Weather Technical Forecast

Issued on Tuesday 11 February 2025 at 12:56 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-class flares. Chance G1 Minor Storms, most likely days 2-3 (12-13 Feb) due to CH14 fast winds.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one isolated M-class flare observed, peaking M1.6 at 11/0535 UTC from AR3981. This has been the most active region on the disc, however this has recently rotated over the northwest limb. There are seven sunspot regions currently on the visible disc, however these are generally small and simple. AR3990 in the southeast, is perhaps the most notable, however this appears to be a mature region dominated by its large leader, with only limited complexity or activity.

No Earth directed CME's were observed from available imagery. A weak filament eruption off the southwest at 11/0120 UTC was deflected far south, likely by the fast winds from the large coronal hole, while a further filament eruption was observed just southeast of centre disc, however no CME has been identified.

Solar Wind / Geomagnetic Activity: The ongoing influence of the fast wind of CH13 was observed. Solar wind speeds persisted at elevated, between 500-600km/s, while density was near or just below average. Interplanetary Magnetic Field strength, Bt, was weak between 6-8nT. The north-south component, Bz, was also weak but mainly negative (southwards-directed) with brief positive intervals, ranging between -7nT to +7nT. Phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Unsettled to Active (Kp3-4).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 persisted at background. High energy electron flux (greater than 2MeV) at GOES16 was background to Moderate, peaking 658 pfu at 10/1900 UTC. The associated 24-hour fluence persisted below the Active threshold, recording 1.01e7 integrated pfu at 11/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low activity expected with a chance of further M-class flares on day 1 (11 Feb). Lower chance of M-class flares days 2-4 (Feb 12-14) with AR3981 retreated beyond the northwest limb.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing fast wind influence from CH13/- is expected day 1 (11 Feb), before easing a little and then transitioning into

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the fast wind from CH14/- on Days 2-3 (12-13 Feb). Unsettled to Active geomagnetic activity is forecast with a chance of G1 Minor Storms, most likely with the transition into CH14 days 2-3 (12-13 Feb), and any CIR region that is observed.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is forecast to persist at background with only a slight chance of rising due to any notable flares from AR3981 in the northwest. High energy electron flux observed at GOES16 is expected to see a gradual rising trend, both at first and again later in the period, with the likelihood of periods of High flux. The associated 24 hour fluence is currently expected to remain below Active, but with a likely rising trend, especially day 4 (14 Feb).

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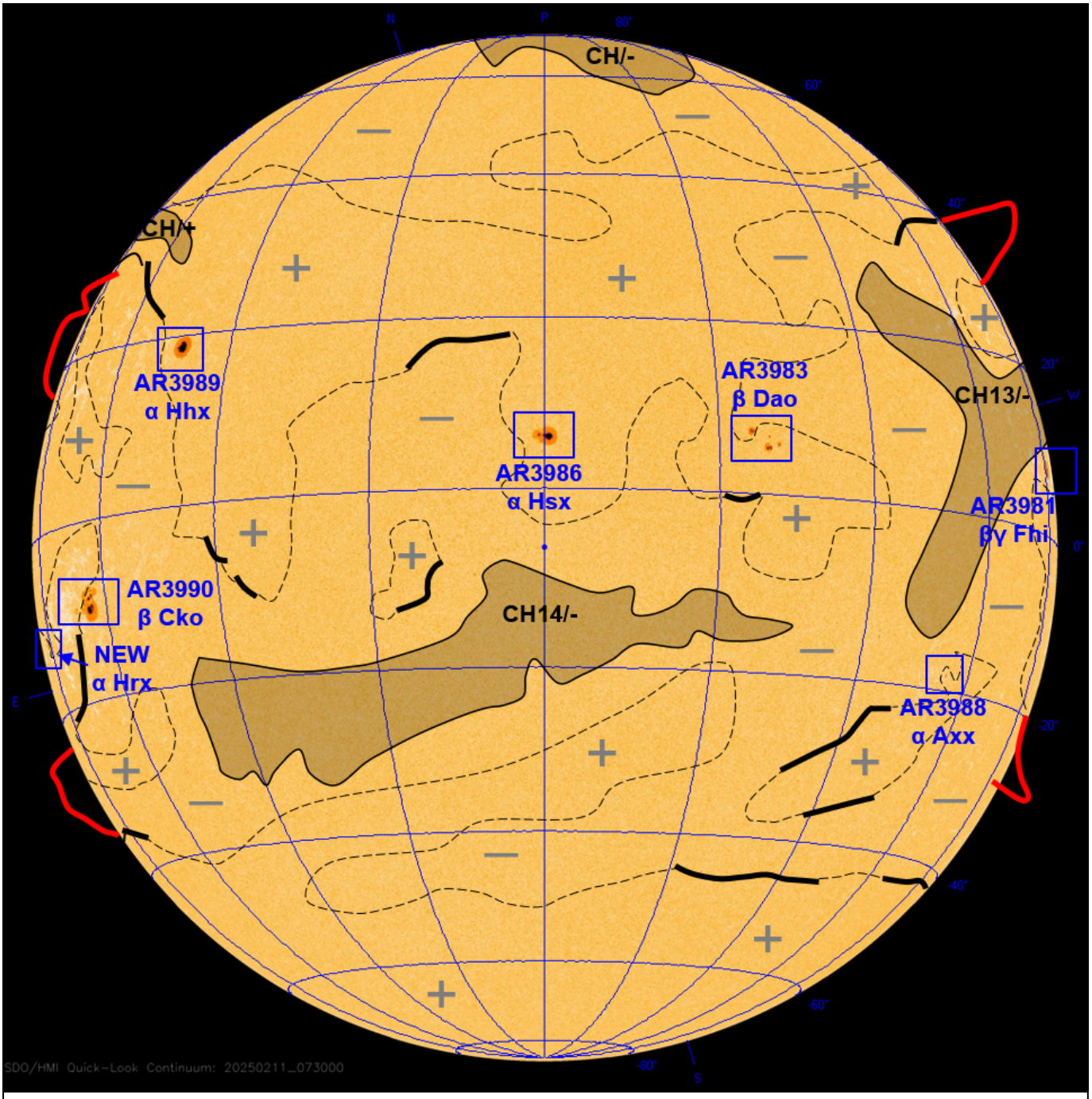
Figure 1: MOSWOC Solar Synoptic Map 11/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs. The previously mentioned potential CME enhancements appear have either missed or been too weak have a notable impact on the solar wind environment.

Ongoing fast winds from CH13/- are expected to continue through Day 1 (11 Feb), perhaps with a slightly declining trend into Day 2 (12 Feb), easing towards 450km/s. The next enhancement is then expected later Day 2 or into Day 3 (12/13 Feb) from a connection to the high speed stream from CH14/-. This is an elongated feature across a similar latitude to Earths current heliographic projection, but has seen its western extent reduced in size compared to previous rotation. Any subsequent enhancement from this feature is low confidence in terms of the timing of onset, but is likely to become Elevated to Strong (500-600km/s) by day 4 (14 Feb), before persisting at this level. This is largely supported by MOSWOC Enlil, which is showing a slight rise in speed from day 2 (12 Feb), peaking later on day 3 (13 Feb).

Quiet to Active conditions expected through the period, with the greatest chance of Quiet periods on Day 1 and early Day 2 (11-12 Feb), and again later on Day 4 (14 Feb). However, there is a chance of isolated G1 intervals throughout due to the ongoing fast solar winds, but most likely with the onset of CH14/- later day 2 or early day 3 (12-13 Feb).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	50	50	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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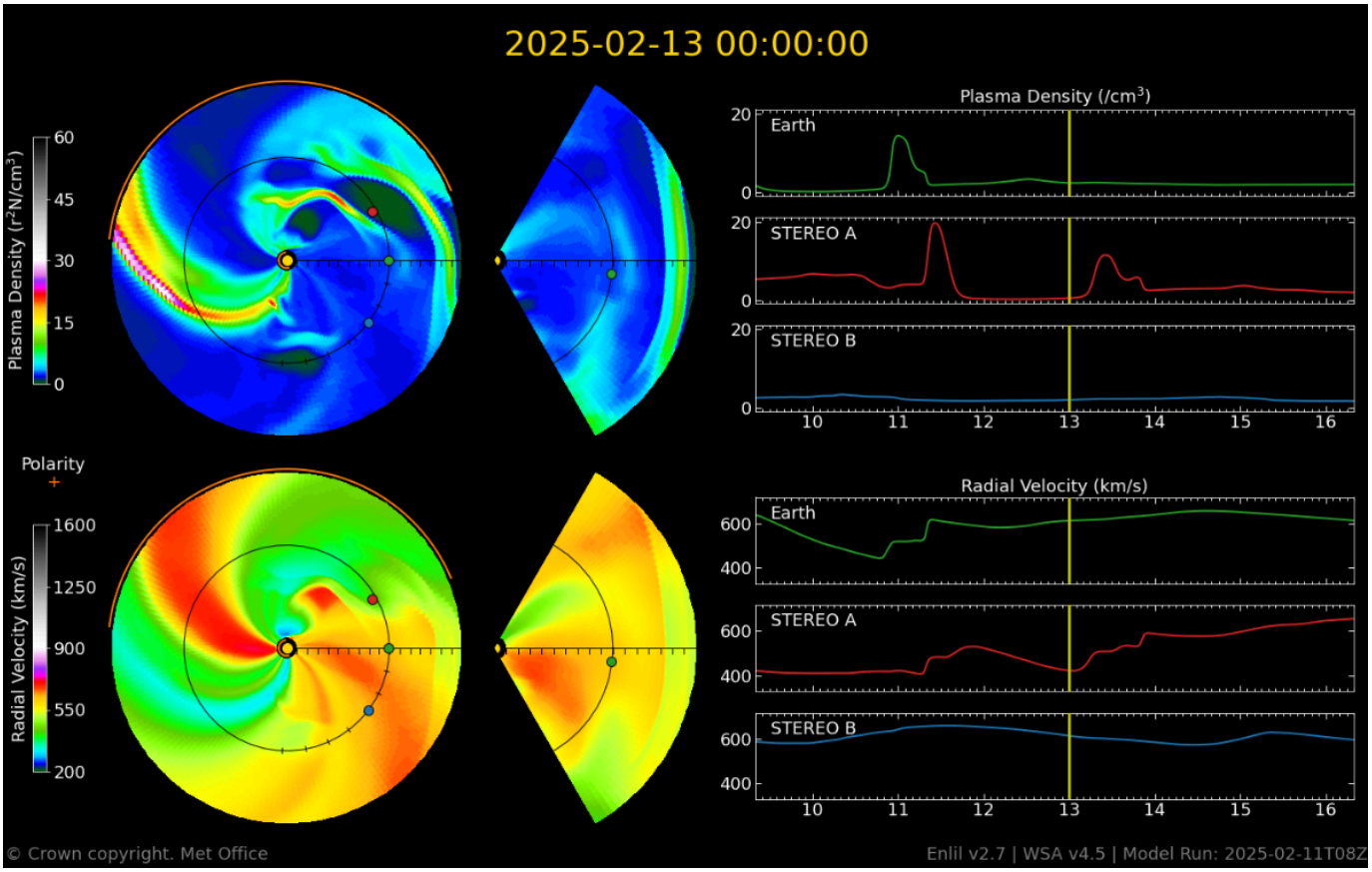
Figure 2: MOSWOC Enlil - Showing enhancement from southern coronal hole (CH14) from late 12-13 Feb, then persisting



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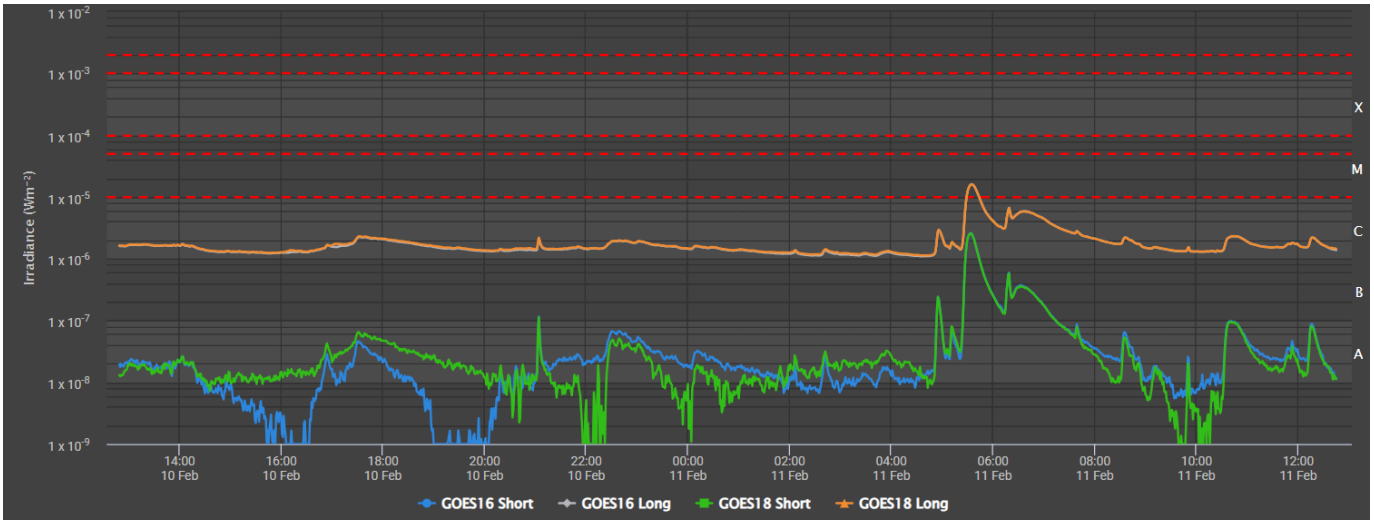
Radio Blackouts - X-Ray Flares

Moderate activity is likely at first with isolated M-flares, although this risk is expected to soon decline a little with AR3981, the source of the majority of the recent activity now over the western limb. However, there will still be a chance of isolated M-flares days 2-4 (12-14 Feb).

There are seven sunspot regions on the disc, with the most notable of these perhaps AR3990 in the southeast. This is comprised predominately of a large and likely mature leader spot, set within a broad area of plage, and followed by a small trailer. This region has remained relatively inactive while on the visible disc, however further details may become apparent as this moves to a less oblique viewing angle. While the other regions remain smaller and simpler, SDO imagery does indicate further clustered magnetic looping beyond the east limb, which could relate to a number of returning regions that could potentially move onto the disc during this period. This remains low confidence at this stage.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	40	40	50
Very Active	R3-R5 (X Class)	No	5	1	1	5

Figure 3: GOES 16/18 X-ray Irradiance



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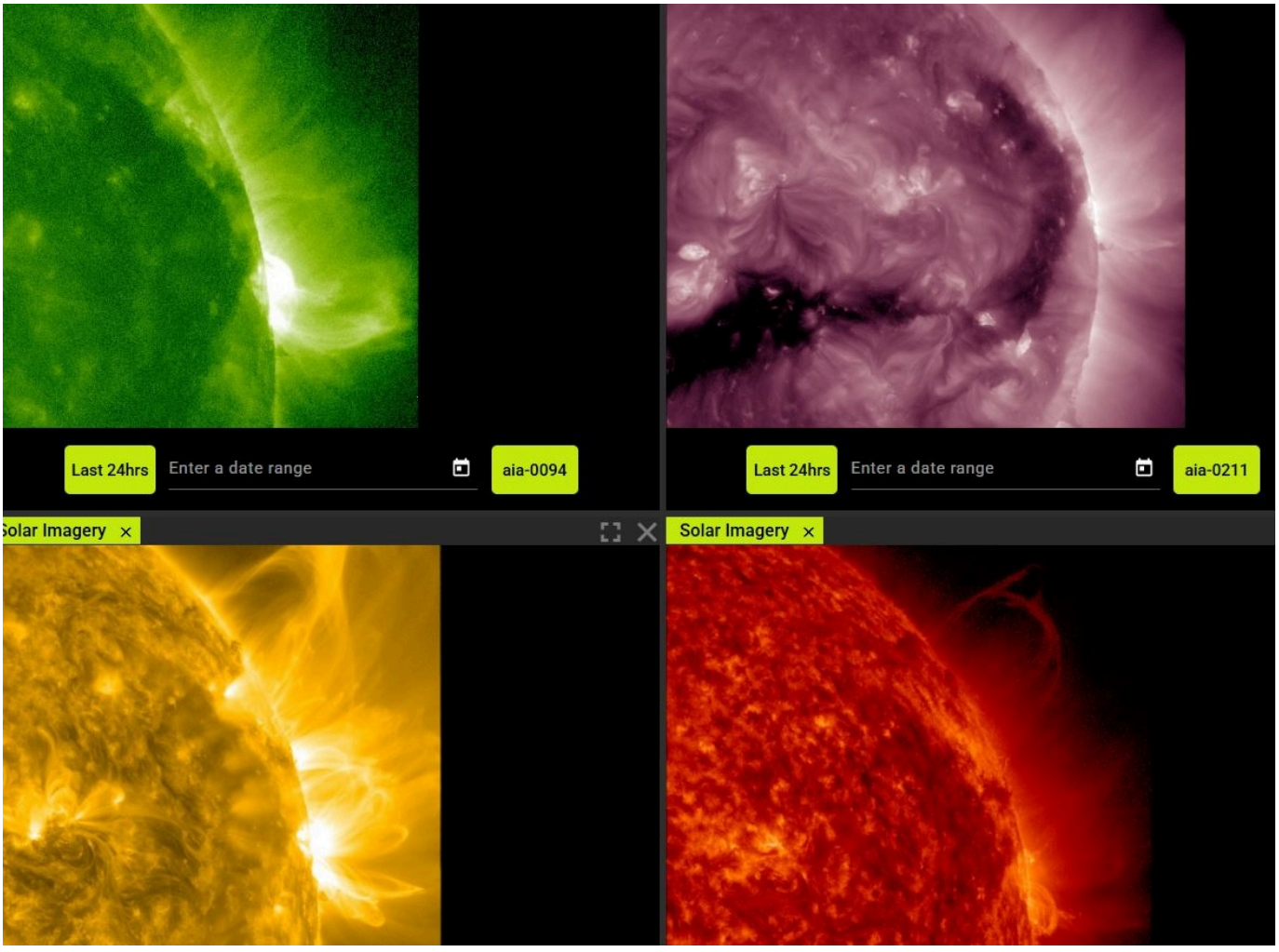
Solar Radiation Storms (High Energy Protons)

GOES-16 proton flux is forecast to persist at background with only a very slight chance of enhancement from any notable flares. This is most likely from AR3981 just over the northwest limb, with some notable magnetic looping evident above the active region. However, this has shown some sign of simplification in the last few days before rotating over the limb, limiting this potential. This potential recedes day 3 (13 Feb) as this region moves further onto the far-side.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO imagery of AR3981 over the northwest limb



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High Energy Electrons (≥ 2MeV)

High energy electron flux observed at GOES16 has been Background to Moderate, however the ongoing enhancement from CH13/- fast winds is expected to have charged the Van Allen belts for lower orbits, leading to the observed flux rising as winds ease a little and this charge migrates out to GEO. This picture is complicated, however, by the expected further connection to CH14/-, most likely occurring either late day 2 or day 3 (12-13 Feb), with the associated onset and any geomagnetic activity likely suppressing the observed flux for a time, before a further rise is expected day 4 (14 Feb).

The corresponding 24-hour fluence is expected to be below the Active threshold, but with a rising trend probable. This is supported by MOSWOC REFM, and while likely under-forecasting a little at first, this doesn't account for the potential further fast wind connection later in the period, and any subsequent suppression in the observed flux.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	1	5	5	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 5: GOES 16 >2MeV electron Flux and associated 24 hour fluence

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